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ABSTRACT

In measuring attitudes by Semantic Differential, bipolar adjective scales with high loadings on an evaluative factor derived by Principal Components Analysis are used typically as unidimensional attitude measures. Komorita and Bass, using conventional statistical techniques, report the discovery of more than one evaluative factor. This paper focuses on four considerations for establishing evaluative factors: concept complexity, eigenvalue cutoff criteria, eigenvalue plot, and conceptual analysis of scale groupings. Komorita's and Bass's data and new data from ratings of six concepts of varying complexity are analysed and discussed. Specific recommendations are made regarding determination of evaluative scales in attitude research. (Author)

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How Many Es Are There? -- A critical analysis of problems concerning determination of evaluative factors of Semantic Differential Scales[1]

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Semantic Differential scales are widely used for attitude measurement both in research and applied settings. Frequently, a unidimensional conception of attitude is either expressed or implied by investigators in selecting scales which load on an "evaluative" factor (E). Difficulties arise, however, where more than one factor emerges that could be labeled as "evaluative". Komorita and Bass (1967), for example, report finding three E factors in principal components analysis of data from 220 Ss' ratings on 16 bipolar adjective scales of the concepts "American Foreign Policy in Vietnam" and "Draft Deferments for Married Students". The scales were selected on the basis of previously reported high loadings on a single E factor (Osgood, et al., 1957). Komorita and Bass' finding creates difficulties for attitude research. If the three E solutions were general, then to operationalize a hypothetical "attitude" construct using S.D. scores would be hazardous; does one use one E, two Es, or three Es? How many Es are there?

Objectives of this paper involve analysis and comparison of new and old data concerning the determination of evaluative factors underlying Semantic Differential scales for use in attitude measurement. Specifically, this work focuses on the problems associated with one or more E factors.

Data and Procedures

New analyses of Komorita and Bass' correlation matrices were performed. We chose data gathering and statistical analysis procedures which are most widely-used and available for attitude research. Thus, principal components analysis and Varimax rotation procedures ("Little Jiffy") were used. Alternate analyses were performed to check the suitability of "Little Jiffy". Additionally, Veldman's (1967) "Relate" procedure was used to compare different factor solutions. In the reanalysis of Komorita and Bass' data, three common conventions for determining the number of factors to rotate were investigated: eigenvalue cutoff criterion, eigenvalue (and log eigenvalue) plot (Cattell, 1966, p.206), and that each additional factor must contribute more than 5% once 75% of the total variance is accounted for (Harman, 1968, p.168). Since the eigenvalue = 1 criterion had been used in the study reporting three E factors, the same data were reanalysed by rotating, two, three, and four factors orthogonally and obliquely.

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Miron (1972) suggested that with a small number of concepts, oblique rotation may more accurately characterize the "meaning domain" of the concepts. To check this we performed oblique rotations on the Komorita and Bass data and compared results to Varimax rotations. A direct quartimin rotation produced essentially the same factor structure in terms of scale loading patterns as the Varimax rotation shown in Table 5. Based on these results, Varimax rotations were used exclusively for subsequent analyses. However, it should be noted that correlations between obliquely rotated factors (from -.59 to +.36) suggest a more cautious interpretation of multiple E factors. The question of oblique vs. orthogonal rotation was deferred for later study.

Nonstatistical analyses of concept verbal complexity and logical scale groupings were considered. The two original concepts were phrased such that Ss could potentially focus on a part of the stated concept (e.g., only upon "American Foreign Policy"). We decided to compare the factor structures of two verbally "wordy" concepts, including one of those originally used by Komorita and Bass with the structures of four verbally "simpler" ones. New data were collected and analysed using over 100 Ss' (Canadian College Students) ratings of the concepts "American Foreign Policy in Vietnam", "Economic Development of Northern Canada", and the verbally simpler concepts "American Foriegn Policy", "Vietnam", "Economic Development", and "Northern Canada". The same 18 bipolar adjective scales were used for each concept, including all 16 scales from the original Komorita and Bass study.

Results

Number of Factors to Rotate. Using the conventional eigenvalue cutoff criterion (eigenvalue $\geq$ 1) produced an arbitrary distinction between two statistically similar factors. Results shown in Table 1 indicate Factors III and IV, for both concepts, are associated with eigenvalues barely above and below 1, respectively. Discarding Factor IV solely on the magnitude of its associated eigenvalue would render questionable the retention of component three with a nearly identical value. Thus, a two or four factor solution might be preferable to the three factors originally reported.

INSERT TABLE 1 ABOUT HERE

The importance of the fourth component became clearer when Veldman's (1967) "relate procedure" was applied in order to maximize the fit between the three- and four-factor solutions. The cosines of the angles between the factors produced in the "relate procedure" are shown in Table 2. These cosines can be interpreted in the same way as correlation coefficients between factors.

INSERT TABLE 2 ABOUT HERE

Table 1. Comparison of Eigenvalues and Percentage Variance After Rotation*

Concept: American Foreign Policy in Vietnam (N=220)			
		Percent Variance	
FACTOR	EIGENVALUE	3-Factor	4-Factor
		%	%
1	7.683	29.28	26.49
2	1.797	14.17	12.30
3	1.174	23.14	16.28
4	0.905	-----	17.17
TOTAL ...	-----	66.59	72.24

Concept: Draft Deferments for Married Students (N=220)			
		Percent Variance	
FACTOR	EIGENVALUE	3-Factor	4-Factor
		%	%
1	8.143	29.07	25.77
2	1.647	21.97	19.25
3	1.273	18.10	17.86
4	0.828	-----	11.44
TOTAL ...	-----	69.14	74.32

*Komorita and Bass (1967) data reanalysed

Table 2. Intercorrelations for 3-Factor and 4-Factor Solutions*

Concept: American Foreign Policy in Vietnam (N=220)			
4-Factor Solutions	3-Factor Solutions		
	1	2	3
1	0.9520	0.0267	0.0351
2	0.0886	0.9162	0.1181
3	0.1550	-0.3337	0.7536
4	0.2468	-0.2204	-0.6458

Concept: Draft Deferments for Married Students (N=220)			
4-Factor Solutions	3-Factor Solutions		
	1	2	3
1	0.9673	-0.0307	-0.0380
2	-0.0501	0.9482	0.0106
3	0.0182	-0.0356	0.9963
4	0.2478	0.3143	0.0770

*Komorita and Bass (1967) data reanalysed

For the concept "American Foreign Policy in Vietnam", Factor IV has a substantial negative correlation with Factor III of the three-factor solution, and Factor IV is comparatively uncorrelated with the first two factors. For the concept "Draft Deferments for Married Students", Factor IV proves to be statistically separable from the other factors. So far, these results indicate Factor IV is a separate factor. It should be noted that the fourth factor is produced in contradiction to Komorita and Bass' suggestion of a three factor structure for their two concepts. The only difference between the two analyses (Komorita and Bass' and that performed here) is the employment of eigenvalue cutoff criteria-producing two, three, or four factors rather than an eigenvalue cutoff criterion greater than or equal to one-producing exclusively a three-factor solution.

In addition, Factor IV brings the proportion of total variance accounted for in the solution to around 75% (Table 1). Barely more than 5% of the total variance is attributable to Factor IV. Harman (1968) points out that the 75 + 5% criterion is a standard for determining number of rotation factors. Based on this criterion, a 4-factor structure can be rotated.

Eigenvalue plots may be employed in two ways. The log of the eigenvalue for each factor can be plotted against the ordinal value of the factor. In this way one can visually illustrate the magnitude of the factors in order to decide whether or not the factors are suitable for rotation. A second method is to plot the actual eigenvalue for a factor against its ordinal value, again, with the same purpose in mind. Figure 1 and Figure 2 demonstrate eigenvalue plots (log and actual value, respectively), for Komorita and Bass' data (4-Factors). Clearly, the curves for each concept change direction at Factor II. Cattell (1966) suggests that factors lying beyond the change point may be considered residual or "Scree". Based upon these criteria, one, perhaps two factors, could be selected for rotation.

INSERT FIGURES 1 AND 2 ABOUT HERE

At this point, it appears that the number of E factors, one, two, three, or four, which emerge in a data set depends on the statistical convention adopted for factor selection.

Nonstatistical Considerations. In general, it should be noted that a verbally "wordy" concept may be associated with a single or multiple E factor structure. Conversely, a verbally "simple" concept (one, two, or three words) may be associated with either a simple or multiple factor structure. Thus, four concept-factor-structure types can be conceptualized:

TYPE 1	"Single" concept/single E factor
TYPE 2	"Single" concept/multiple E factor
TYPE 3	"Wordy" concept/single E factor
TYPE 4	"Wordy" concept/multiple E factor

FIGURE 1

FIGURE 1 - Log eigenvalue - component plots for two concepts - based on Komorita and Bass (1967)

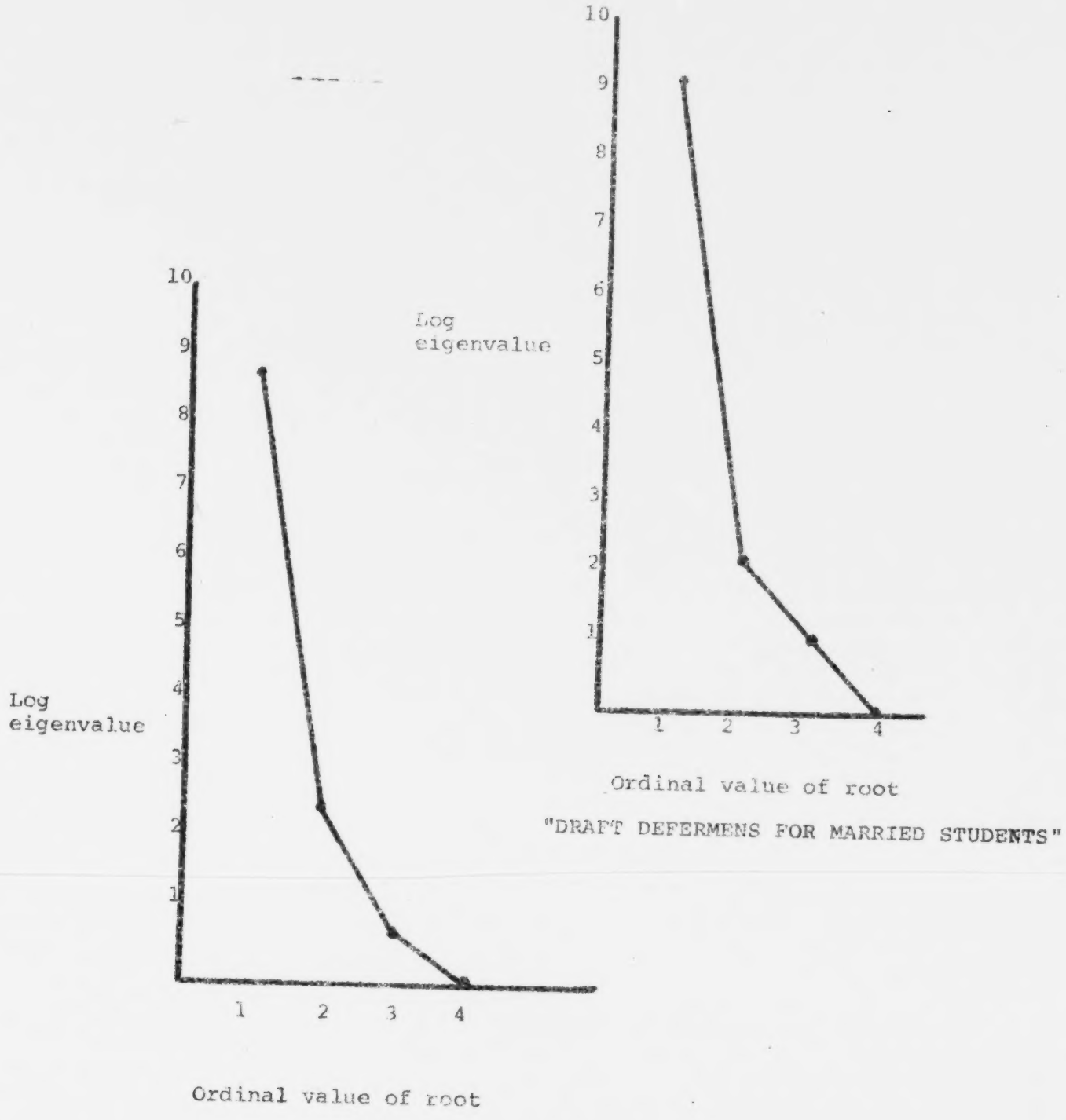
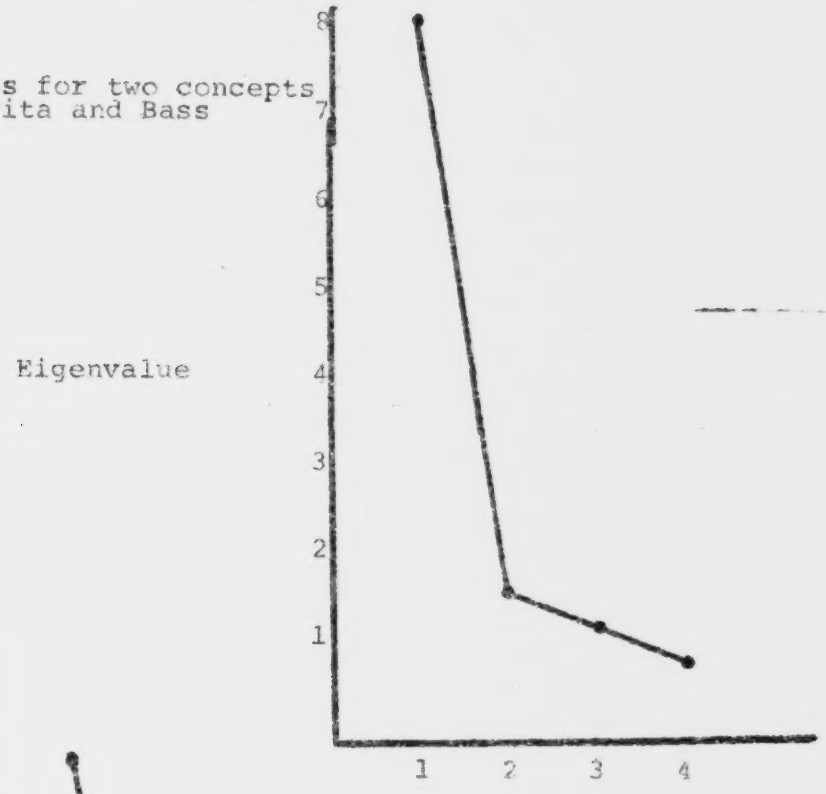


FIGURE 2

FIGURE 2 - Eigenvalue
- component plots for two concepts
- based on Komorita and Bass (1967)



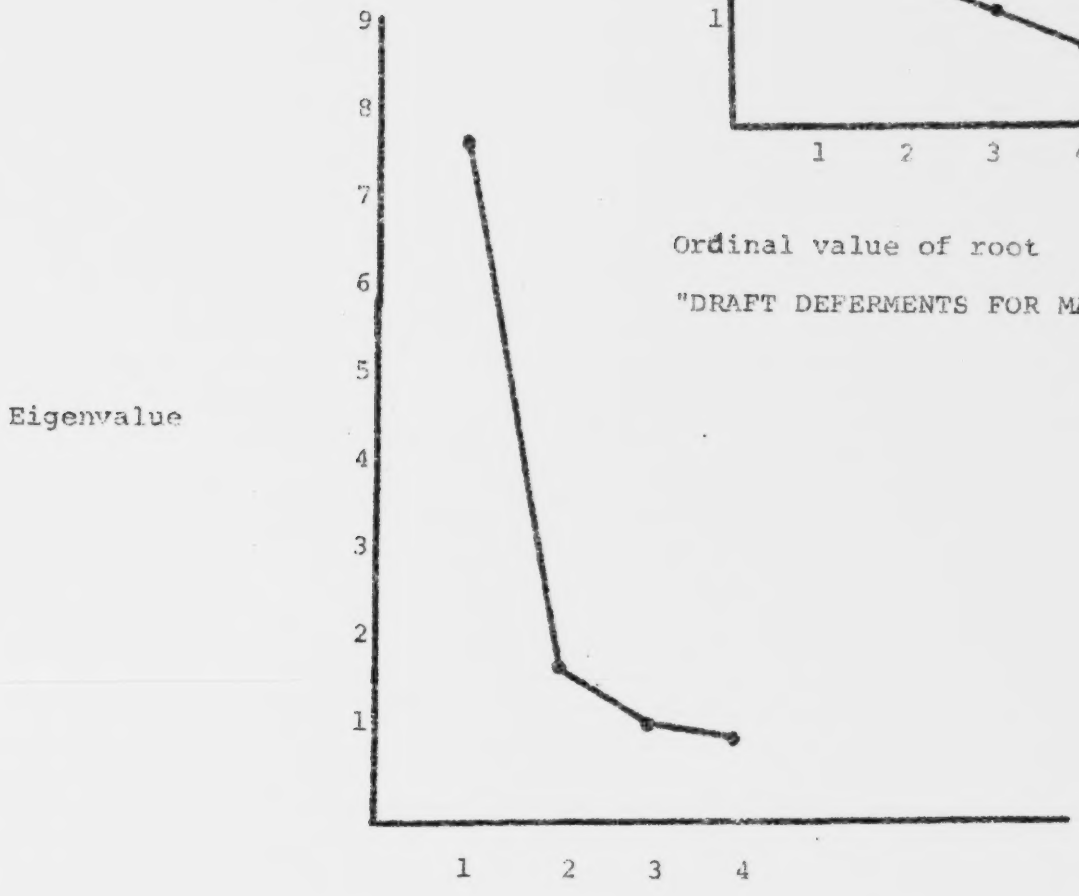


Table 3 contains an illustration of each type for the six concepts, three for "American Foreign Policy in Vietnam" and three for "Economic Development in Northern Canada". The emphasis here is on concept effects not on the possibilities of concept by scale or concept by person interactions. These are discussed briefly below.

INSERT TABLE 3 ABOUT HERE

Logical analyses of "evaluative" scales reveal a variety of scale clusters which can be checked empirically. Komorita and Bass described a three E factor structure for the two concepts with 10 common scales. They used a factor loading cutoff criterion of 0.50. We used Veldman's "Relate" procedure to check empirically their solution. As illustrated in Table 4, more scales could be included, but the composite scale clusters seem similar. Also, Komorita and Bass' E factor labels seem to be appropriate.

INSERT TABLE 4 ABOUT HERE

Evaluative labels for scale clusters play a role in determining what is considered to be "evaluative." Komorita and Bass interpreted their composite 3-factor solution as three evaluative components, "functional-utilitarian", "affective-emotional", and "moral-ethical" (Table 5). The 4-factor composite solution shown in Table 5 yields a fourth component which could be interpreted and labelled "compassionate". Factor IV was derived by teasing out scales "kind-cruel", and "clean-dirty" from Factors II and III, respectively. In addition, the "fair-unfair" scale shifted to the "moral-ethical" component and scales "nice-awful" and "agreeable-disagreeable" became more ambiguous in their loadings. Thus, the 4-factor solution retains the basic pattern proposed by Komorita and Bass, but may provide additional insight into the data.

INSERT TABLE 5 ABOUT HERE

Discussion

With the help of Komorita and Bass' data, we have tried to demonstrate the effects of three traditional criteria for selecting factors to rotate. The criteria are:

1. Eigenvalue = 1
2. Eigenvalue (and log eigenvalue) plot
3. 75 + 5% total variance

TABLE 3. Concept Complexity and Multiple E Factors

CONCEPT	TYPE[a]	# FACTORS[b]	% Variance Accounted
"Vietnam"	1	1	75.2
"American Foreign Policy"	2	3	77.6
"American Foreign Policy in Vietnam"	3	1	81.8
"Economic Development"	2	3	71.3
"Northern Canada"	2	4	70.5
"Economic Development in Northern Canada"	4	3	78.4

[a] TYPE 1 - "Simple" Concept/Single E factor
2 - "Simple" Concept/Multiple E factors
3 - "Wordy" Concept/Single E factor
4 - "Wordy" Concept/Multiple E factors

[b] N > 100 (Canadian College Students)

TABLE 4. Composite Scales for Characterizing the Three-Factor Solution based on combining the Concepts using Veldman's "Relate" Procedure

Scale	FACTORS[a]		
	I-functional[c]	II-affective	III-moral
1	approve		
2	wise		
3	valuable		
4		kind[b]	
5			clean
6	beneficial		
7			honest
8	fair[b]		
9	good[b]		
10		nice[b]	
11		pleasant	
12			trustworthy
13		attractive	
14	agreeable[b]		
15	satisfactory		
16			sincere

a Factor loadings are available upon request.
b Scales characterized by the "relate" procedures, but rejected by Komorita and Bass.
c Komorita and Bass' labels.

Table 5. Composite of Scale Clusters for Komorita and Bass' Data using a 4-Factor Solution

SCALE	FACTORS			
	I-Functional	II-affective	III-ethical	IV-compassionate
1	approve[a,b]			
2	wise			
3	valuable			
4				kind
5				clean
6	beneficial			
7			honest	
8			fair	
9	good			
10		nice[c]		nice[c]
11		pleasant		
12			trustworthy	
13		attractive		
14	agreeable[c]	agreeable[c]		
15	satisfactory			
16			sincere	

[a] Based on a reanalysis of Komorita and Bass' data using Veldman's "Relate" Procedure.
[b] Factor loadings shown are 0.50.
[c] Factor loadings 0.50 in more than one factor.

In addition, Veldman's "Relate" procedure was demonstrated as one means of comparing factor structures. Finally, we described three nonstatistical considerations which influence decisions concerning factor interpretation. These are:

1. concept complexity
2. scale clustering
3. factor labelling

The question is: HOW MANY Es ARE THERE? The answer remains equivocal. First, what statistical conventions are planned for the data analysis? Second, what definition of attitude is preferred by the investigator? And third, what interactions between concepts, scales and persons are expected and observed in the data? Depending on one's answers to these questions, the Komorita and Bass data could be interpreted as a one, two, three or four factor solution, all justifiable by one or more conventional statistical and/or logical criteria.

Implications for Application of Contemporary Attitude Theory

To Komorita and Bass' finding of 3 E factors: 1) functional-utilitarian; 2) affective-emotional; and 3) moral-ethical, we have added the possibility of a fourth. From their own data, a "compassionate" evaluative factor emerged with similar eigenvalue magnitude to the moral-ethical component. Clearly, one's a priori definition of "attitude" can be a guide in deciding how to proceed from here.

Fishbein (1967) harking back to early work of L.L. Thurstone, chooses to make a case for a unidimensional definition of attitude as, "the amount of affect for or against a psychological object"(p.389). This is operationalized as an evaluative response which indexes one's "evaluation" of a concept (i.e., its 'goodness or badness'), p.389. Presumably, investigators who operate from this point-of-view would take the E component having the highest loadings with the good-bad scale as an index of attitudes. Other "E components" might be taken as belief indices or statements of the probability that the concept was useful, moral, compassionate, etc. Moreover, attitudes taken as evaluative aspects of beliefs need not necessarily be indexed by scores which are orthogonal to belief scores.

If one were to hold a multidimensional conceptualization of attitude (e.g., Krech, Crutchfield, and Ballachey, 1962), the problem then becomes to assign multiple E factors to one or more of the a priori construct dimensions. Of "cognition", "affect" and "conation", goodness and badness (like Fishbein's "attitude") would appear to relate most closely to affect. Cognition might be associated with beliefs (other"E components"and possibly P and A), whereas conation may look like what Triandis (1971) measure with the behavioral differential indexes.

Were one to adopt a more empirical stance, one could accept a well-developed Thurstone, Likert or Guttman scale (for instance), as a standard, and develop semantic differential scales with an eye to high positive correlations with the standard. The definition of "attitude" implicit here is a variant of Jack Stephens' famous phrase, "by 'attitude' I mean that which my (well-developed) attitude scale measures."

The point of this discussion is to suggest that the investigator should not let Little Jiffy define what he means by attitude, rather, he should define his construct before he begins the careful process of developing appropriate concepts and scales (C.F. Nunnally, 1967; Heise, 1969; and McKie and Foster, 1972 for advice on scale and concept selection).

Suggestions for Further Research and Implications for Practice

It has become common to caution users of the semantic differential to beware of concept - scale interactions, and to investigate the factor structure of intended scales for one's concepts and Ss (e.g., Nunnally, 1967, pp 539-540). More recently, researchers and practitioners have been advised to specify logically (Heise, 1969), and investigate empirically (McKie and Foster, 1972) the structure of the concept domain under consideration. The present study in the context of the research literature on semantic differential analysis and attitude measurement suggests further considerations. Some of these are noted below.

Multiple E "salience", and social desirability. Nichols and Shaw (1964) purport to provide evidence to the effect that as "salience" of a concept increases for a group of subjects (e.g., concept "church" as opposed to "college professor" for a group of churchgoers) correlations between E scores and Thurstone scale scores drop (e.g., from .76 to .39). Presuming that this finding is reliable (a 24 item Thurstone scale and a 5 scale SD, measuring a "highly-refined" E component were used), one may well ask, if there were a multiple E structure (say affective, moral and functional) whether with increasing salience, the pattern of correlations with an external standard (e.g., Thurstone scale) might not shift? Perhaps salience results in an attenuation of variance in one E component, but clear separation of people on some other E dimension is associated with a more (highly focused) specific set of beliefs about the object or concept.

Likewise, Ford and Meisels (1965) show high correlations between an empirically determined E factor and a measure of social desirability. The pattern of such correlations across multiple Es for a set of concepts, scales and persons would be of potential interest, as would the relationship between social desirability and "salience" as discussed above. Studies to investigate these and related questions remain to be performed.

One approach to such a problem might be in the use of three-mode factor analysis (Tucker, 1966), wherein a cube of persons by concepts by scales data is factored without having to collapse along one dimension. Wiggins and Fishbein (1969), in fact, have provided evidence for "person" factors. Thus, it might not be sufficient to consider merely concept by scale interactions, but also interactions of persons by concepts (e.g., Nichols and Shaw, 1964), persons by scales (e.g., Wiggins and Fishbein, 1969), and the triple interaction, persons by scales by concepts.

Conclusions

Investigators and consumers of research alike need to be wary of the conventions for when to stop factoring. Blind dependence upon the machine and on widely-used procedures may well yield confusing or misleading results. Moreover, an *a priori* attitude construct and its clearcut operational definition are *sine qua non* as prerequisites to the design of research in this area. The finding of multiple "evaluative" factors or components is not new (C.F. Osgood, *et al.* 1957). It does, however, present problems for attitude theory as well as empirical issues, which require recognition if not resolution, in practice. We have attempted to identify some key statistical and conceptual considerations, and suggest some areas requiring further research.

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In order to check the principal components results in terms of factor reliability Alpha Factor Analysis was performed (Kaiser, H.F., and Caffres, T. "Psychometric method of factor analysis" unpublished paper, 1963). For comparability the data factored were Komorita and Bass' matrix of scale intercorrelations for the concept "American Foreign Policy in Vietnam", and our data matrix for the same concept. (The IBM 360 computer at the University of Illinois at Champaign-Urbana was employed for these analyses).

The results of the Alpha Factor Analysis are unmistakably clear. There is only one E factor associated with acceptable levels of reliability. The three Alpha Reliabilities of the three Komorita and Bass "E" factors are .98, .64, and .24, respectively. For the new data, factors I and II had reliabilities of .996 and .051 respectively.